STRETCHED LENS ARRAY (SLA) PHOTOVOLTAIC CONCENTRATOR HARDWARE DEVELOPMENT & TESTING

Michael F. Piszczor
NASA Glenn, 21000 Brookpark Rd., Cleveland, OH 44135, USA
Mark, J. O'Neill
ENTECH, Inc., 1077 Chisolm Trail, Keller, TX 76248, USA
&
Michael Eskenazi
AEC-Able Engineering Co., 7200 Hollister, Goleta, CA 93117, USA

Over the past two years, the Stretched Lens Array (SLA) photovoltaic concentrator has evolved, under a NASA contract, from a concept with small component demonstrators to operational array hardware that is ready for space validation testing. A fully-functional four panel SLA solar array has been designed, built and tested. This paper will summarize the focus of the hardware development effort, discuss the results of recent testing conducted under this program and present the expected performance of a full size 7kW array designed to meet the requirements of future space missions.

REVIEW ABSTRACT

Applicable subject number: III (III-V, Space Cells and Systems)
Preferred mode of presentation: Oral
Correspondence: Michael F. Piszczor, Jr.
NASA Glenn Research, MS302-1, 21000 Brookpark Rd., Cleveland, OH 44135, USA
Phone: 216-433-2237, Fax: 216-433-6106, E-Mail: michael.piszczor@grc.nasa.gov

STRETCHED LENS ARRAY (SLA) PHOTOVOLTAIC CONCENTRATOR HARDWARE DEVELOPMENT & TESTING

Michael F. Piszczor
NASA Glenn, 21000 Brookpark Rd., Cleveland, OH 44135, USA

Mark J. O'Neill
ENTECH, Inc., 1077 Chisolm Trail, Keller, TX 76248, USA
Phone: 817-379-0100, Fax: 817-379-0300, E-mail: mjoneill@entechsolar.com
&
Michael Eskenazi
AEC-Able Engineering Co., 7200 Hollister, Goleta, CA 93117, USA
Phone: 805-685-2434, Fax: 805-685-1369, E-mail: MEskenazi@aec-able.com

Over the past two years, the Stretched Lens Array (SLA) photovoltaic concentrator has evolved from a concept with small component demonstrators to operational array hardware that is ready for space validation testing. Based on the same general concept as the SCARLET concentrator design that was successfully demonstrated on the NASA Deep Space 1 mission, the Stretched Lens Array is a performance-optimized solar array that is based on this previously successful concept. Under a NASA contract, the SLA design was further refined and array hardware was designed, fabricated and tested. This paper will summarize the focus of this hardware development effort, discuss the results of recent testing conducted under this program and present the expected performance of a full size 7kW array designed to meet the requirements of future space missions.

A fully-functional sub-scale four panel SLA solar array has been built under the contract to demonstrate and test the deployment and performance characteristics of the SLA design. A photograph of this hardware is shown in Figure 1. The array was partially populated with high efficiency multibandgap concentrator cells from multiple solar cell vendors. Power production from these live circuits was measured under simulated solar conditions. This data, along with other array performance characteristics will be presented. Using the hardware and performance parameters obtained from the sub-scale hardware, a 7kW (BOL) single-wing array was designed. The features of this specific array are summarized in Table I. This design possesses a number of key advantages: a specific power of over 180 watts/kg (BOL), an areal power density of 300 watts/square meter and a stowed power density of 9kW/cubic

meter. The array is also designed to operate at 300 volts with minimal interactions to the space plasma environment. This high voltage feature has been verified by module-level testing within a simulated space environment. These solar array features make the SLA concept a viable power system candidate for many future space missions.

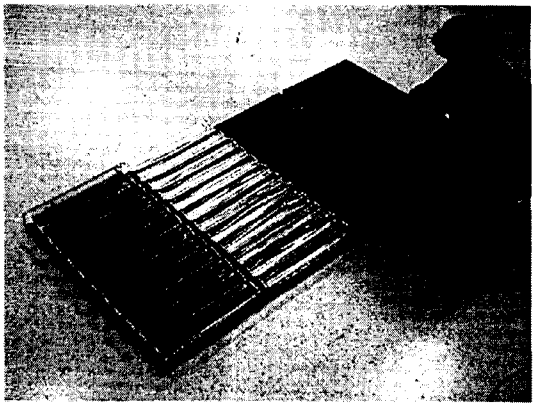

Figure 1 – Prototype SLA Wing

Table I. Performance features of a 7kW (BOL) Stretched Lens Array single-wing design.

Feature	Value or Characteristic
Point Design Basis	7,129 Watts (BOL)
SLA Implementation	Pop-up lenses
Base Platform Design Maturity	Most components flight proven on DS1
Specific Power	183 W/kg
Stowed Volume	0.11 m^3/kW
Stowed Stiffness	40 Hz
Deployed Stiffness	0.1 Hz
Stowed Power	Easily implemented on outer panel
Ease of Adding Planar Panel	Easily implemented on outer panel
Flatness & Warping	Well understood flat stable platform
Deployment Testing	Can use existing off-loaders
Power Testing	Pop-up lenses allow each panel to be tested as a complete assembly before wing integration
Commercial Appeal	Easier to integrate on commercial spacecraft. Readily accepted configuration.
Self Shadowing	No self shadowing